(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 199 442
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 86301524.4

(22) Date of filing: 04.03.86

(51) Int. Cl.⁴: A 63 B 21/00

(30) Priority: 12.04.85 JP 78989/85

(43) Date of publication of application:
29.10.86 Bulletin 86/44

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI NL SE

(71) Applicant: TSUYAMA MFG. CO., LTD.
8-25 Kuwazu 2-chome Higashisumiyoshi-ku
Osaka-shi Osaka-fu(JP)

(72) Inventor: Tsuyama, Sadaharu
4-21 Fuminosato 3-chome Abeno-ku
Osaka-shi Osaka-fu(JP)

(74) Representative: Seaborn, George Stephen et al,
c/o Edward Evans & Co. Chancery House 53-64 Chancery Lane
London WC2A 1SD(GB)

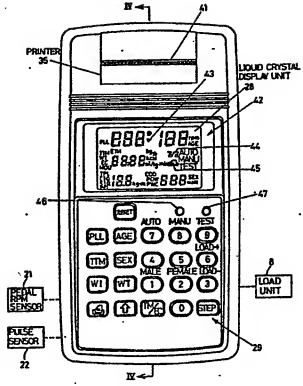
(54) Exerciser.

(57) In the first place, inputted from a key switch portion (29) is a personal identification code for a person to use the exerciser. In response to this, personal data corresponding to the identification code are read from the storage means, to be set as the user's data. Thereafter the user performs exercise by driving a load unit (8), whereby data on the user's pulse are successively supplied from a pule sensor (22) to a microcomputer (24). The microcomputer (24) controls the load level of the load unit (8) on the basis of the user's personal data as set in the aforementioned manner and changes in the pulse rate data during the exercise, thereby to adjust conditions of the exercise that can be performed by the user in accordance with the situation and desired conditions of the user's exercise.

EP 0 199 442 A2

./...

FIG.1


IV
41
PRINTER
35
LIQUID CRYSTAL
DISPLAY UNIT
28
43
42
44
45
46
47
AUTO
MANU
TEST
PLL
AGE
TTM
SEX
WT
MALE
FEMALE
LOAD
STEP
9
LOAD
UNIT
21
PEDAL
RPM
SENSOR
PULSE
SENSOR
22
29
IV

TITLE OF THE INVENTION

Exerciser

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an exerciser used in the field of health apparatuses for developing users' physical strength, in which a crank shaft receiving load torque is rotated by pedals. More particularly, it relates to an exerciser which is employed as a health apparatus for home use.

Description of the Prior Art

There have generally been provided various kinds of treadle-type sporting apparatuses (such sporting apparatuses are hereinafter referred to as "exerciser" in this specification) for readily taking exercise by working pedals.

In such conventional techniques, Japanese patent publication gazette No. 8267/1983 discloses the prior art of interest for the present invention. Namely, the said gazette discloses an exerciser formed by a mechanical structure portion including a frame, a rotating portion including a pedal, a brake portion of an eddy current system, a control system including a sensor and a control panel including a display window.

In the invention disclosed in the aforementioned publication gazette, the exerciser is in such structure that the user inputs target exercise data every time he uses the exerciser so that the control system in the exerciser controls the amount of load applied to the brake portion on the basis of the data. Thus, the user must input his personal data through the control panel each time before use by troublesome data input operation.

Further, in the invention described in the aforementioned publication gazette, the brake torque (amount of load) is uniformly controlled and cannot sufficiently follow the user's physical conditions which vary with the case. In other words, the brake torque cannot be accommodated by control to the manner of increase in the user's pulse rate and the target pulse rate level varying with the case. Therefore, the said exerciser cannot automatically make the user perform training in a preferable manner for increasing his pulse rate to reach the target level and maintaining the same correspondingly to individual difference.

It is an object of the present invention to provide an exerciser which overcomes the aforementioned respective disadvantages.

SUMMARY OF THE INVENTION

The present invention is in such structure including a load unit to be driven by the user, a pulse data detecting means provided in relation to the load unit for detecting the pulse data of the user driving the load unit, a storage means which previously stores personal data such as the user's age and physical strength, a identification code input means for inputting a personal identification code for specifying the user, a means for reading personal data corresponding to the inputted identification code from the storage means and a control means for controlling conditions of exercise which can be performed by the load unit on the basis of the read personal data and data on the pulse rate of the user in exercise obtained from the pulse detecting means.

In the first place, inputted from the identification code input means is a personal identification code for a person to use the exerciser. In response to this, personal data corresponding to the identification code are read from the storage means, to be set as the user's data. Thereafter the user performs exercise by driving the load unit, whereby data on the user's pulse are successively supplied from the pulse data detecting means to the control means. The control means controls the load level of the load unit on the basis of the user's personal data as set in the aforementioned manner and changes in the

pulse rate data during the exercise, thereby to adjust conditions of the exercise that can be performed by the user in accordance with the situation and desired conditions of the user's exercise.

According to the present invention, personal basic data including age and sex are previously stored so that the data can be readily called by personal codes, whereby the user of the exercise is released from trouble of inputting the personal basic data every time he uses the exerciser.

Further, the load unit is so controlled as to present a load level corresponding to the personal basic data, i.e., age, sex, physical strength and the like, thereby to attain an appropriate training effect in response to individual difference.

The load torque is controlled on the basis of target level of the pulse rate in the automatic training mode, whereby the user can take ideal exercise while maintaining the target pulse rate.

Further, since the function of the physical strength test mode is provided, the user can immediately perform a physical strength test thereby to objectively recognize his physical strength level by comparing the same with standard physical strength data. Thus, the exerciser can

be widely used for confirming general physical strength and health care.

In addition, the exerciser according to the present invention is provided with the printer for printing the training data and the physical strength test data to be kept for user in long-term care for physical strength and care.

Further, the liquid crystal display unit displays a number of items for simultaneously showing various types of numerical data, whereby required data can be readily simultaneously confirmed conveniently.

These object and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a control panel characterizing the present invention;

Fig. 2 is illustrative of the entire structure of an exerciser according to an embodiment of the present invention;

Fig. 3 is a block diagram showing the structure of a control system of the exerciser;

Fig. 4 is a sectional view of the control panel shown in Fig. 1 taken along the line IV - IV with internal structure being omitted;

Fig. 5 is a diagram for illustrating display contents displayed on the liquid crystal display unit;

Fig. 6 is a diagram for illustrating recording contents printed by a printer;

Fig. 7 is an illustration showing key sequence for setting or changing initial data in an automatic training mode;

Figs. 8, 9 and 10 are flow charts for illustrating controlling operations in respective modes;

Fig. 11 is an illustration showing the content of personal basic data stored in a microcomputer;

Fig. 12 is a flow chart showing a control operation for evaluating physical strength; and

Fig. 13 is a graph showing standard levels of physical strength.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Detailed description is now made on an embodiment of the present invention with reference to the drawings.

First, the features of this embodiment are listed as follows:

(1) Personal basic data for respective users are previously stored in a storage means, whereby

corresponding personal basic data can be read by inputting a user's personal code (identification code). Thus, the user is released from troublesomeness of inputting his personal basic data every time he starts using the exerciser.

The personal basic data are set for respective modes as hereinafter described as follows:

For automatic training mode: code number (personal code), age, sex, target pulse rate, target time, upper bound pulse rate

For manual training mode: code number, age, sex, upper bound pulse rate, target time, initial load set value

For physical strength test mode: code number, age, sex, upper bound pulse rate, weight, load increase width set value.

The respective basic data can be appropriately changed if necessary.

(2) The mode of the exerciser according to this embodiment can be selected by the user from the automatic training mode, manual training mode and physical strength test mode.

When the automatic training mode is selected, the exerciser is so controlled that the level of the pulse rate detected from the user is coincident with the target

level, while the load level is controlled so as to maintain the coincident state of the user's pulse rate with the set target level. Therefore, the user can take exercise in constant load strength for his heart function under training in said training mode.

When the user starts the exercise in the case where the physical strength test mode is selected, the exerciser is controlled to increase the load torque in a staged manner in set increase width per constant time. Then the pulse rate levels and power (watt) at the ends of respective load stages are stored thereby to calculate the maximum power capacity "PWC" and the maximum oxygen uptake "MOU" per unit weight and unit time. The "MOU" level is compared with a previously stored list of physical strength level ranks, thereby to objectively evaluate the user's physical strength level.

(3) The exerciser according to the embodiment is provided with a display unit having large display capacity and a printer. Therefore, the display unit can simultaneously display a great amount of information, whereby the user can simultaneously confirm required information. Further, training data, physical strength test data or the like are printed out with the exercise, whereby the user can effectively use the printed data for his health care etc.

Description is now definitely made on the embodiment of the present invention.

Fig. 2 illustrates the entire structure of an exerciser embodying the present invention. A frame 1 made of structural material includes at least a base 2, a front support 3 and a rear support 4 which are variable in height. The front support 3 is provided in its upper end portion with a handle 5 bent in the form of a loop in its plane and a control panel 6. The control panel 6 contains a control function unit within the same and is provided on its surface with a keyboard for inputting various data and a data indicating display, as hereinafter described. A saddle 7 is mounted on the upper end portion of the rear support 4. Further, a load unit 8 is provided on the platform 2.

The load unit 8 includes a crank shaft 10 mounted to the rear support 4 having pedals 9 and a load shaft 12 supported by a support frame 11 provided on the base 2. The crank shaft 10 and the load shaft 12 are connected with each other by a speed increasing mechanism 13 having two speed increasing steps. The speed increasing mechanism 13 is formed by a crank wheel 14, a chain 15, a free wheel 16 and the like, and the speed increasing rate thereof is set at 16.6.

The load shaft 12 is fixedly provided with a disc 17 of copper plate, the peripheral edge of which is held in a non-contact manner by a C-shaped core 19 of a brake coil 18, thereby to form an eddy current brake. This load unit 8 is described in more detail in Japanese patent application No. 28780/1985 filed in the name of the applicant.

Fig. 3 is a block diagram showing structure of a control system in the embodiment. In Fig. 3, a pedal rpm sensor 21 is provided in relation to the pedal 9 as shown in Fig. 2, for detecting the number of rotation of the pedal 9. Definite structure of such sensor 21 is described in detail in Japanese utility model application No. 6734/1984 filed in the name of the applicant.

A pulse sensor 22 is mounted on the earlobe of a user of the exerciser, thereby to detect the user's pulse rate. This pulse sensor 22 may be prepared by that described in Japanese patent application No. 28779/1985 filed in the name of the applicant. A pulse amplifier 23 connected with the pulse sensor 23 is adapted to amplify the pulse rate detected by the pulse sensor 22, and may be formed integrally with or separately from the pulse sensor 22.

Data detected by the pedal rpm sensor 21 and the pulse sensor 22 are supplied to a microcomputer 24. The microcomputer 24 includes a single-chip CPU 25 having a

memory function and an extension port 26 for extending the memory function.

Output data from the microcomputer 24 which performs arithmetic etc. on the same are driven by a liquid crystal driver 27 thereby to be displayed on a liquid crystal display unit 28. The output data are further printed by a printer 35 on printing paper. Further, a key switch portion 29 and a timer 30 are coupled to the microcomputer 24. The key switch portion 29 is provided with keys for selecting modes of the exerciser and those for inputting personal data or the like. The timer 30 has a function of measuring prescribed time intervals required for the microcomputer 24. A buzzer 32 is further coupled to the microcomputer 24 through a buzzer amplifier 31. The buzzer 32 is adapted to notice the user of the exerciser termination of prescribed exercise and give alarms in emergency.

The microcomputer 24 controls the brake coil 18 (see Fig. 2) through a digital-to-analog (D-A) converter 33 and a brake coil current control amplifier 34. The brake coil 18 is so controlled as to control the eddy current brake, i.e., to control the amount of the load applied to the load unit of the exerciser. An example of such control is described in Japanese patent application No. 28780/1985 filed in the name of the applicant.

The aforementioned microcomputer 24, liquid crystal driver 27, liquid crystal display unit 28, key switch portion 29, timer 30, buzzer amplifier 31, buzzer 32, D-A converter 33 and brake coil current control amplifier 34 are contained in or provided on the surface of the control panel 6 as shown in Fig. 2.

The control panel 6 is now described with reference to Figs. 1 and 4.

Fig. 1 is a plan view of the control panel 6, and Fig. 4 is a cross-sectional view taken along the line IV - IV of Fig. 1, illustrative of simplified internal structure. Referring mainly to Fig. 1, the control panel 6 is provided on its surface with a recording paper exit window 41 of the printer 35, a display window 42 in which the liquid crystal display unit 28 is fitted and the key switch portion 29 in order from above.

The display region of the liquid crystal display unit 28 fitted in the display window 42 is widely formed in order to simultaneously display various data required for the user of the exerciser. The display contents of the data displayed on the liquid crystal display unit 28 can be switched by the mode of the exerciser or selection by the user. Fig. 1 shows a state in which the whole displayable contents are displayed.

The key switch portion 29 has various types of keys so as to input necessary commands, data and the like.

Description is now made on various symbols displayed on the display panel 6 as shown in Fig. 1.

Symbol "PLL" indicates the upper bound pulse rate, and the display of this symbol "PLL" on the liquid crystal display unit 28 is indicative of that the numerical value in the right-hand side thereof indicates the upper bound pulse rate. The "PLL" key in the key switch portion 29 is pressed in order to change the numerical value of the upper bound pulse rate displayed on the liquid crystal display unit 28.

With respect to the display on the liquid crystal display unit 28, symbol "ETM" indicates elapsed time, "TTM" target exercise time, "WT" user's weight, "EC" calorie exhausted by exercise, "MOU" user's maximum oxygen uptake, "TPL" target pulse rate, "CTQ" current load torque, "STQ" set load torque, "PFL" user's physical strength level, "rpm" number of rotation of pedal, "AGE" user's age, "AUTO" automatic training mode, "MANU" manual training mode, "TEST" physical strength test mode, "COD" personal code, "POW" power, "PWC" maximum power capacity and "SEX" user's sex. A heart mark 43 goes on and off in response to input of the pulse data. A mark 44 indicates

a state under exercise, and a mark 45 is indicative of an activated state of the printer 35.

Symbols shown on respective keys in the key switch portion 29 are similar to the aforementioned contents, and corresponding keys are pressed in order to display desired data on the liquid crystal display unit 28 and to change the data in display. Within the said keys, a "WI" key is for setting and changing exercise strength, "RESET" key for reset operations, "↑" key for feeding recording paper of the printer 35, "TM/EC" key for switching time/calorie display and "STEP" key for advancing a program to a next one. Further, "7·AUTO", "8·MANU" and "9·TEST" keys, respectively serving as ten keys, also have functions of selecting the mode of the exerciser, "6·LOAD+" and "3·LOAD-" keys are ten keys also having functions of indicating increase or decrease in the amount of the load applied to the load unit, and "1·MALE" and "2·FEMALE" keys are ten keys also having functions for inputting the user's sex.

Further, arranged in the upper right side of the key switch portion 29 are a power supply lamp 46 which is turned on/off in response to power supply on/off states of the display panel 6 and a battery life indicator lamp 47 (turned on when replacement of the battery is necessary).

Referring now to Figs. 5 and 6, description is made on contents displayed on the liquid crystal display unit 28 and recording contents printed out by the printer 35 in the respective modes.

Figs. 5(1) to 5(6) illustrate display contents displayed on the liquid crystal display unit 28 in the automatic training mode, Figs. 5(7) to 5(9) those in the manual training mode and Figs. 5(10) to 5(12) those in the physical strength test mode respectively. Fig. 6(1) illustrates the recording content in the automatic training mode, Fig. 6(2) that in the manual training mode and Fig. 6(3) that in the physical strength test mode.

(1) Description on display and recording contents in automatic training mode:

When the power supply switch is turned on, the liquid crystal display unit 28 displays the content as shown in Fig. 5(1). The printer mark 45 indicates that the printer 35 operates simultaneously with starting of the operation, and when recording of the exercise is unnecessary, a printer mark switch in the key switch portion 29 is pressed to turn off the mark 45.

When the "7·AUTO" key is pressed, the liquid crystal display unit 28 displays the content as shown in Fig. 5(2). Namely, remaining is only the display telling that the automatic training mode is selected from the three

modes shown in vertical three rows in Fig. 5(1). It is to be noted that when the "8·MANU" key is pressed, the display training mode is displayed as "MANU" indicative of the manual training mode in place of "AUTO" while the same is displayed as "TEST" indicative of the physical strength test mode when the "9·TEST" key is pressed.

Then, when a personal code is inputted by a ten key, the liquid crystal display unit 28 displays the content as shown in Fig. 5(3). Since this embodiment is applied to an exerciser of home use, the personal codes are expressed by single figures so as to specify the user by nine numerals "1" to "9". A "0" key functions as an initial data setting key for non-registrants.

Displayed upon the input of the personal code are the said code ("2" in the display as shown in Fig. 5(3)) and the upper bound pulse rate "PLL" stored in the memory correspondingly to the said personal code, target exercise time "TTM", target pulse rate "TPL", age "AGE" and sex "SEX". The sex is indicated by "1" for the male and "2" for the female. The numerical value of the upper bound pulse rate "PLL" is generally automatically displayed by "200 - age", whereas such display may be changed.

Thus, initial setting and change of personal basic data called in response to the personal code can be performed in accordance with key sequence as shown in Fig.

7. Symbol x of (x, x) in Fig. 7 is indicative of optional ten keys.

Description is now made on display contents under exercise in the automatic training mode. The display contents are shown in Figs. 5(4) and 5(5).

When the "STEP" key is pressed, control is started to display the content as shown in Fig. 5(4), whereby the heart mark 43 goes on and off in response to the pulse while the current pulse rate (e.g., "79") is displayed. The numerical value of the current load torque "CTQ" is automatically set in 0.5 Kg·m as the initial value and displayed.

When the exercise is started, the content of Fig. 5(5) is displayed thereby to display current values of the pulse rate, elapsed time "ETM", current load torque "CTQ", number of pedal rotation and power "POW" respectively. In order to match the actual pulse rate with the target level "TPL", the current load torque "CTQ" is automatically increased or decreased in steps of 0.1 Kg·m when the pulse rate is out of the range of ±5 per minute. Fig. 5(6) shows a state in which the exercise is terminated and the "TM/EC" key is pressed to display the exhausted calorie.

When the "TM/EC" key is pressed, the display content of the liquid crystal display unit 28 is shifted to the display of the exhausted calorie "EC" in place of the

elapsed time "ETM", even if the user is under exercise. Display switching between the elapsed time "ETM" and the exhausted calorie "EC" may be alternately selected by the "TM/EC" key.

After the lapse of the target exercise time in the automatic training mode, the microcomputer 24 (see Fig. 3) supplies a signal to the buzzer amplifier 31, thereby to operate the buzzer 32. On the other hand, when the "STEP" key for starting the exercise is pressed, the printer 35 prints exercise conditions and the like and then prints the current value of the pulse rate "PLS" and that of the power "W" on printing paper every 30 seconds, so long as the operation setting for the printer 35 is not released. Fig. 6(1) shows the format thereof. The user can take the exercise while observing the state of this recording. The pulse rate is also recorded on a graph in addition to printing of the numerical values. When the exercise is terminated and the "STEP" key is pressed by the user, the calorie "EC" exhausted during the exercise is printed whereby the printed is stopped. This recording paper can be utilized as material for health care for the user, and particularly the exhausted calorie data "EC" can be used as the data for beauty and reduction of weight for women.

(2) Description on display and recording contents in the manual training mode:

When the "8·MANU" key is pressed in the initial display as shown in Fig. 5(1), the manual training mode corresponding to Fig. 5(2) is selectively displayed and when the personal code is inputted by the ten key in the said display, the liquid crystal display unit 28 displays the content as shown in Fig. 5(7).

In the display as shown in Fig. 5(7), the numerical value of the set load torque "STQ" (e.g., "1.5 Kg·m") can be set at or changed to an optional value by a key operation "WI" -- "x" -- "x" ("x" indicates optional ten key). Other data are set and changed in a similar manner to the automatic training mode.

When the exercise is started after the "STEP" key is pressed, the liquid crystal display unit 28 displays the content as shown in Fig. 5(8). Such display is similar to the display of the automatic training mode as shown in Fig. 5(5) except for that the current load torque "CTQ" is displayed with the set torque "STQ" as the initial value and increased or decreased by operations of the power "6·LOAD+" and "5·LOAD-" keys.

The time display of the elapsed time "ETM" and the calorie display of the exhausted calorie "EC" can be selectively switched by the "TM/EC" key.

When the "STEP" key for starting the exercise in the manual training mode is pressed, the printer 35 starts

printing of the recording data in the format as shown in Fig. 6(2).

(3) Description on display and recording contents in the physical strength test mode:

When the "9•TEST" key is pressed in the initial display as shown in Fig. 5(1) to selectively display the physical strength test mode corresponding to Fig. 5(2) and then the personal code is inputted by the ten key during this display, the unit displays the content as shown in Fig. 5(10).

In such display, the numerical value of the weight "WT" can be set at or changed to an optional value by key operation "WT" — "x" — "x". Other values are set and changed in a similar manner to the automatic training mode, and these values are automatically called by the personal code and displayed on condition that initial setting is performed.

In the physical strength test mode, the set load torque "STQ" is used as increase width of the load. Such usage is hereinafter described in detail.

When the "STEP" key is pressed to start the operation for controlling the exerciser, the liquid crystal display unit 28 displays the content as shown in Fig. 5(11).

In Fig. 5(11), the numerical value of the current load torque "CTQ" is automatically increased at 3-minute

intervals after the lapse of the first one minute from the initial level of 0.5 Kg·m. The rate of such increase is set in the first place as the value "STQ" of the display by the user in response to his physical strength. In the case of the display according to this embodiment, the said increase is made by 0.5 Kg·m at a time.

When the load level is increased by three times at 3-minute intervals after the lapse of the first one minute, i.e., after the lapse of 10 minutes in total including the first one minute, the liquid crystal display unit 28 displays the content as shown in Fig. 5(12), thereby to display the respective numerical values of the maximum power capacity "PWC", maximum oxygen uptake "MOU" and physical strength level "PFL". The numerical value displayed as the physical strength level "PFL" is divided in five ranks as shown in Fig. 13, as hereinafter described.

Simultaneously with pressing of the "STEP" key for starting, the printer 35 prints changes in the power "watt" and the pulse rate during the exercise every 30 seconds following printing of set conditions in the format as shown in Fig. 6(3). Indication "Inc. TQ. 0.5" in the printed set values shows that increase width of the load is 0.5 Kg·m. After the lapse of 10 minutes, the printer

prints the result of physical strength evaluation and is then stopped.

Figs. 8 to 10 are flow charts of operations centering around the microcomputer 24 for the respective modes as hereinabove described.

Contents of these flow charts are now briefly described.

Referring to Fig. 8, the power source for the control panel 6 is turned on (step S1), whereby the training mode is selected (step S2). This operation is performed by selective pressing of any one of the "7·AUTO", "8·MANU" and "9·TEST" keys by the user. When the automatic training mode is selected by the mode selection, an automatic program set in the CPU 25 (see Fig. 3) is read (step S3), so that the exerciser is controlled along the said automatic program as hereinafter described.

When the personal code is inputted by a ten key (step S4), personal basic data (age, sex, upper bound pulse rate, target pulse rate and target exercise time) corresponding to the personal code are read from the memory to be displayed on the liquid crystal display unit 28 (step S5). Thus, the aforementioned content as shown in Fig. 5(3) is displayed.

The personal basic data read at this time are previously stored in the memory of the microcomputer 24.

Fig. 11 shows an example of the content thereof. As shown in Fig. 11, the personal basic data are stored in units of 8 bits for the respective data by employment of a RAM address per data.

When change of the displayed personal basic data is necessary, such change is made at a step S6. Initial setting is also performed at the step S6. Generally no particular setting nor change is required after the second time use, and hence the step S6 is skipped and the process is advanced to a next step S7. Thus, the user is only required to input his personal code, whereby trouble of inputting a number of personal basic data is saved to prevent complicatedness in data input.

When a starting command signal is inputted at the step S7, the microcomputer 24 operates various sensors and timers so as to perform starting of detection of the pulse rate, automatic setting of the initial load level, starting of detection of the number of pedal rotation, starting of timers and starting of the printer (step S8). When the user rotates the pedals to start the exercise (step S9), the microcomputer 24 performs various control and arithmetic as shown in a step S10.

Namely, the microcomputer 24 detects the user's current pulse rate (step S101), compares the same with the target pulse rate (step S102) and automatically increases

or decreases the load level (step S103). The microcomputer 24 further detects the current number of pedal rotation (step S104) thereby to perform arithmetic on power on the basis of the load level and the number of pedal rotation (step S106). Then it measures the elapsed time (step S105), subtracts the same from the target exercise time (step S107) and operates the buzzer when the elapsed time is up (step S108). Further, the microcomputer 24 performs arithmetic on the exhausted calorie required for the user's exercise from the calculated power (step S106) and the elapsed time (step S109).

The aforementioned respective control and arithmetic processing are performed in a parallel manner by time-divisional interruption processing.

Upon termination of the exercise (step S11), input of a termination command is waited (step S12), and the printer prints the exhausted calorie and is stopped (step S13).

Similarly when, referring to Fig. 9, the manual training mode is selected, the microcomputer 24 performs control according to a manual program. In this case, control and arithmetic contents for the load unit after starting of the exercise are slightly different. Namely, the comparison with the target pulse rate (step S102) and

the control for automatically increasing or decreasing the load level (step S103) in the automatic training mode are not performed, and commands by the "6·LOAD+" and "3·LOAD-" keys are detected in order to increase or decrease the load level (step S305). Other processing is similar to that described with reference Fig. 8.

The physical strength test mode is now described with reference to Fig. 10. Control operation in the physical strength test mode is different at a step S50. Namely, the elapsed time is detected (step S503) and the load level is increased by stages per lapse of a prescribed time, i.e., at 3-minute intervals after the lapse of the first one minute in this embodiment (step S506). Then the power is calculated from the current number of pedal rotation and the amount of load (step S507). When the test is terminated (step S51), arithmetic is performed on the user's maximum power capacity and maximum oxygen uptake "MOU" (steps S509 and S508), thereby to perform arithmetic on evaluation of the physical strength level based on the result (step S52) and the results thus obtained are printed out (step S53).

When the user's pulse rate exceeds the set upper bound pulse rate at the steps S101 to S109 in Fig. 8, steps S501 to S507 in Fig. 9 and steps S301 to S308 in

Fig. 10, the load level is immediately decreased to the minimum (0.5 Kg·m) for safety thereby to stop the control.

The control operation for the evaluation of the physical strength level at the step S52 is performed according to the flow chart as shown in Fig. 12.

Namely, the sex data is read from the personal basic data to select the sex and the age data is read from the personal basic data to select the age group while the rank of the physical strength level is decided by the maximum oxygen uptake "MOU" operated at the step S508 whereby the result of physical strength evaluation is displayed on the liquid crystal display unit 28 and printed by the printer 35.

The respective selected personal basic data and "MOU" value as hereinabove described are previously stored in the memory of the microcomputer 24. The contents thereof are, e.g., those as shown in the graph illustrated in Fig. 13. The user's physical strength level is displayed in five stages by comparison with the data on general physical levels as shown in Fig. 13.

Such physical strength levels vary with American, European and Japanese types as shown in Fig. 13, and hence a manual changeover switch or the like is provided to enable selection as to which type of standard physical strength level the comparison is made with. Such a manual

switch is provided on, e.g., the back surface of the control panel 6. The first block in Fig. 12 is provided for this purpose.

The aforementioned embodiment is applied to an exerciser for home use and hence the personal code is prepared by a single figure so as to save the storage capacity of the memory in the microcomputer 24, whereas such storage capacity may be increased with personal code combinations of a plurality of digits (e.g., combinations of four-figure digits) when the present invention is applied to an exercise for business use such as that located in a sports center, since the number of the users is increased. Or, when ID cards storing personal codes are prepared in a readable manner, personal basic data on users can be called by the said ID cards, whereby the exerciser is made convenient to handle.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

CLAIMS

1. An exerciser which includes:

a load unit driven by a user;

pulse data detecting means provided in relation to said load unit for detecting data on the pulse of said user driving said load unit;

storage means for previously storing personal data such as said user's age and physical strength;

identification code input means for inputting a personal identification code for specifying said user;

means for reading personal data corresponding to inputted said identification code from said storage means; and

control means for controlling conditions of exercise that can be performed by said load unit on the basis of read said personal data and said pulse data of said user in exercise obtained from said pulse data detecting means.

2. An exerciser in accordance with claim 1, wherein said control means includes a safety mechanism for decreasing the load applied to said load unit when said pulse data from said pulse data detecting means exceeds a prescribed safety pulse level.

3. An exerciser in accordance with claim 1, wherein said control means can be set in an automatic training mode by selection by said user, said load applied to said load unit being automatically increased or decreased when said pulse of said user in said exercise deviates from a target pulse level set as one of said personal data out of a prescribed range in said automatic training mode.

4. An exerciser in accordance with claim 1, wherein said exerciser further includes physical strength evaluating means,

said control means can be set in a physical strength test mode by selection by said user, said load applied to said load unit being changed in a plurality of stages at prescribed time intervals in accordance with a previously set physical strength test program in said physical strength test mode,

said physical strength evaluating means being adapted to evaluate said user's physical strength on the basis of said pulse obtained from said pulse detecting means when said control means controls said load unit in the aforesaid manner.

5. An exerciser in accordance with any of claims 1, wherein

said exerciser further includes data display and print means capable of displaying and printing input data inputted by said user, data on results of said user's exercise, data on evaluation of said user's physical strength and the like.

6. An exerciser in accordance with any of claims 1, wherein

said load unit includes:

a load shaft provided with a pedal to be rotated by said user,

a rotating disc coupled to said load shaft to be rotated, and

magnetic flux generating means arranged in a position holding the main surfaces of said rotating disc not to be in contact with said principal surface, to generate magnetic flux across the surface of said rotary disc for supplying damping torque to said rotary disc.

7. An exerciser in accordance with claim 6, wherein

said magnetic flux generator means comprises a core and an exciting coil wound on said core, said core being in C-shaped configuration and arranged to hold said main

surfaces of said rotary disc by opposite opening end surfaces thereof.

8. An exerciser in accordance with any of claims 1, wherein

said pulse data detecting means includes:

a photosensor having a light emitting portion outputting optical signals and a light receiving portion formed by a converter element for converting optical signals into electric signals and having linear optical-electric signal conversion characteristics, said light emitting portion and said light receiving portion being arranged closely to each other to be used in contact with a measured portion of said user,

light emitting portion driving means for supplying driving signals to said light emitting portion thereby to turn said light emitting portion on and off at a frequency exceeding a prescribed frequency level, and

detecting means coupled to said light receiving portion for removing direct current components and low frequency components from output signals generated from said light receiving portion after conversion into said electric signals therein, thereby to detect desired signal components.

9. An exerciser in accordance with claim 8, wherein said light receiving portion of said pulse data detecting means includes a photo diode as said converter element for converting said optical signals into said electric signals.

FIG. 1

0199442

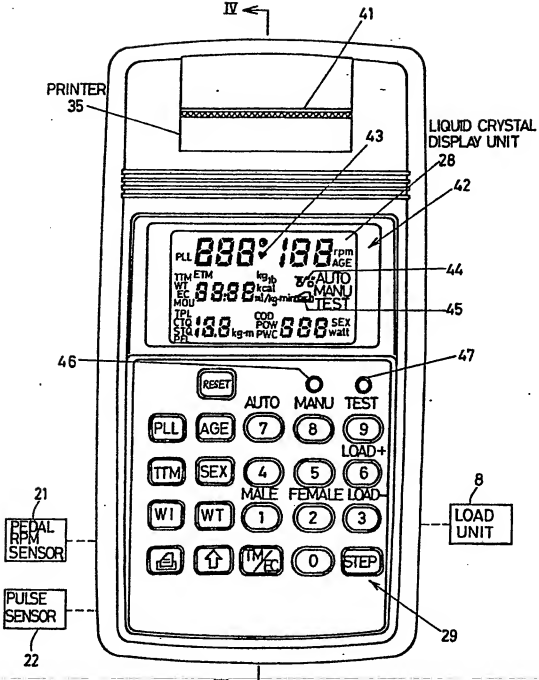


FIG. 2

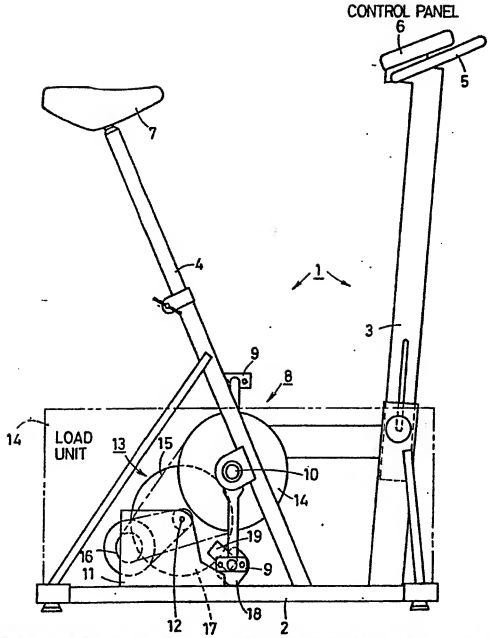

CONTROL PANEL
6
5
7
4
1
3
9
8
14
LOAD
UNIT
13
15
10
14
19
16
11
9
12
17
18
2

FIG. 3

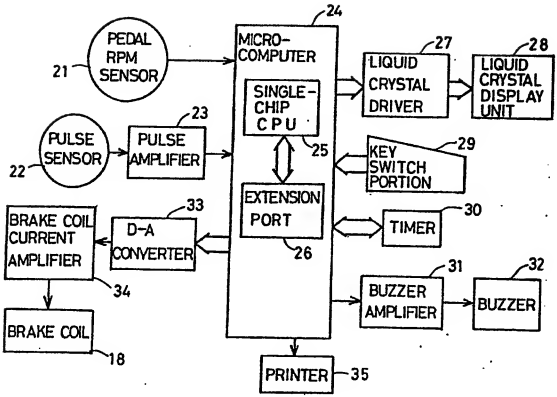

PEDAL RPM SENSOR
21
MICRO-COMPUTER
24
LIQUID CRYSTAL DRIVER
27
LIQUID CRYSTAL DISPLAY UNIT
28
SINGLE-CHIP CPU
25
PULSE SENSOR
22
PULSE AMPLIFIER
23
KEY SWITCH PORTION
29
EXTENSION PORT
26
TIMER
30
BRAKE COIL CURRENT AMPLIFIER
34
D-A CONVERTER
33
BUZZER AMPLIFIER
31
BUZZER
32
BRAKE COIL
18
PRINTER
35

FIG. 4

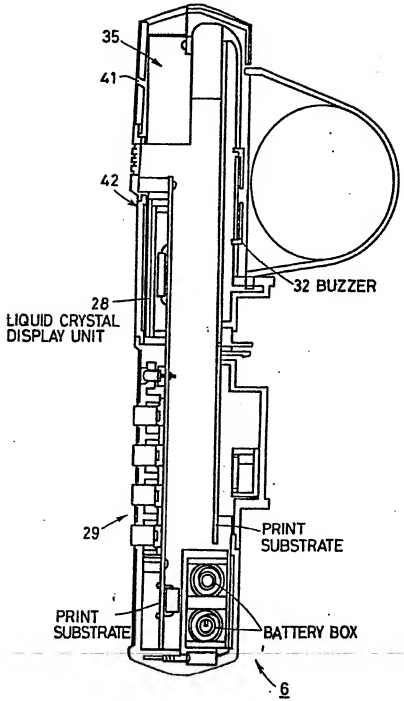

35
41
42
28
LIQUID CRYSTAL DISPLAY UNIT
32 BUZZER
29
PRINT SUBSTRATE
PRINT SUBSTRATE
BATTERY BOX
6

FIG. 5 (1)

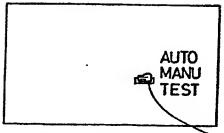


FIG. 5 (2)

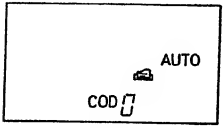


FIG. 5(3)

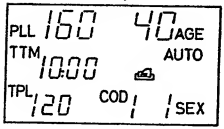
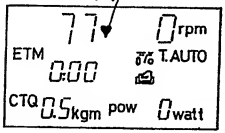


FIG. 5(4)



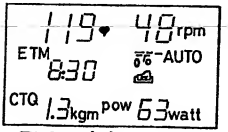


FIG. 5(5)

FIG. 5 (6)

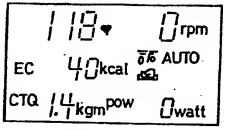


FIG. 6 (1)

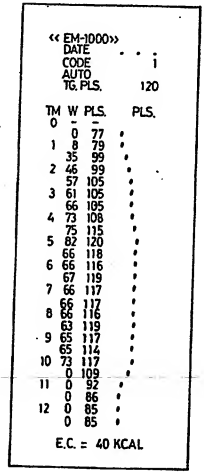


FIG. 5 (7)

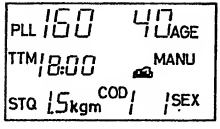


FIG. 5 (8)

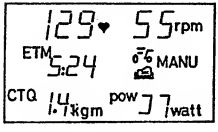


FIG. 5 (9)

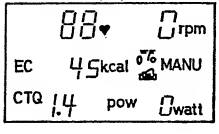


FIG. 6 (2)

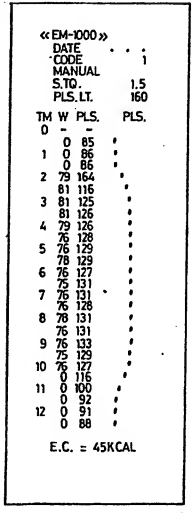


FIG. 5 (10)

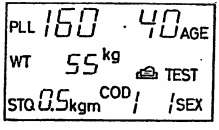


FIG. 5 (11)

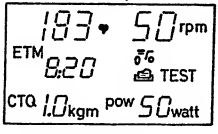


FIG. 5 (12)

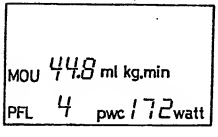


FIG. 6 (3)

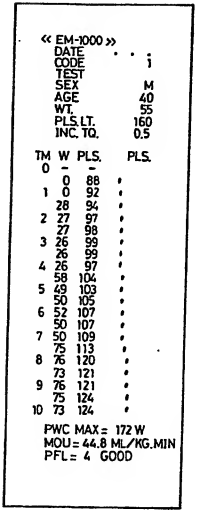


FIG. 7

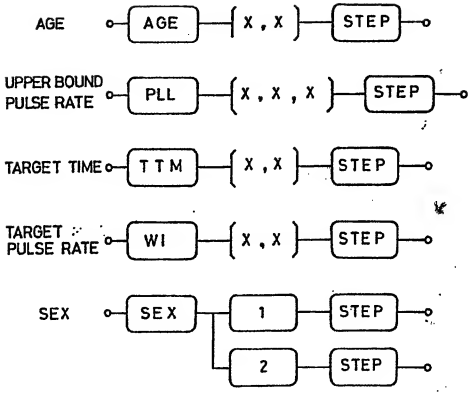

AGE
AGE
X , X
STEP
UPPER BOUND PULSE RATE
PLL
X , X , X
STEP
TARGET TIME
TTM
X , X
STEP
TARGET PULSE RATE
WI
X , X
STEP
SEX
SEX
1
STEP
2
STEP

FIG. 8

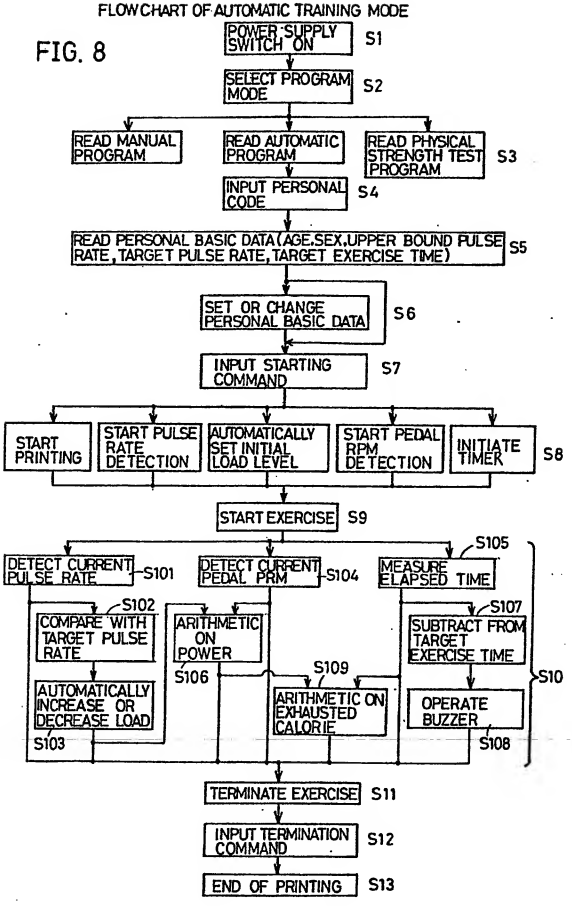

FLOWCHART OF AUTOMATIC TRAINING MODE
POWER SUPPLY SWITCH ON
S1
SELECT PROGRAM MODE
S2
READ MANUAL PROGRAM
READ AUTOMATIC PROGRAM
READ PHYSICAL STRENGTH TEST PROGRAM
S3
INPUT PERSONAL CODE
S4
READ PERSONAL BASIC DATA(AGE,SEX,UPPER BOUND PULSE RATE,TARGET PULSE RATE,TARGET EXERCISE TIME)
S5
SET OR CHANGE PERSONAL BASIC DATA
S6
INPUT STARTING COMMAND
S7
START PRINTING
START PULSE RATE DETECTION
AUTOMATICALLY SET INITIAL LOAD LEVEL
START PEDAL RPM DETECTION
INITIATE TIMER
S8
START EXERCISE
S9
S105
DETECT CURRENT PULSE RATE
S101
DETECT CURRENT PEDAL PRM
S104
MEASURE ELAPSED TIME
S102
COMPARE WITH TARGET PULSE RATE
ARITHMETIC ON POWER
S106
S107
SUBTRACT FROM TARGET EXERCISE TIME
S109
AUTOMATICALLY INCREASE OR DECREASE LOAD
S103
ARITHMETIC ON EXHAUSTED CALORIE
OPERATE BUZZER
S108
S10
TERMINATE EXERCISE
S11
INPUT TERMINATION COMMAND
S12
END OF PRINTING
S13

FIG. 9

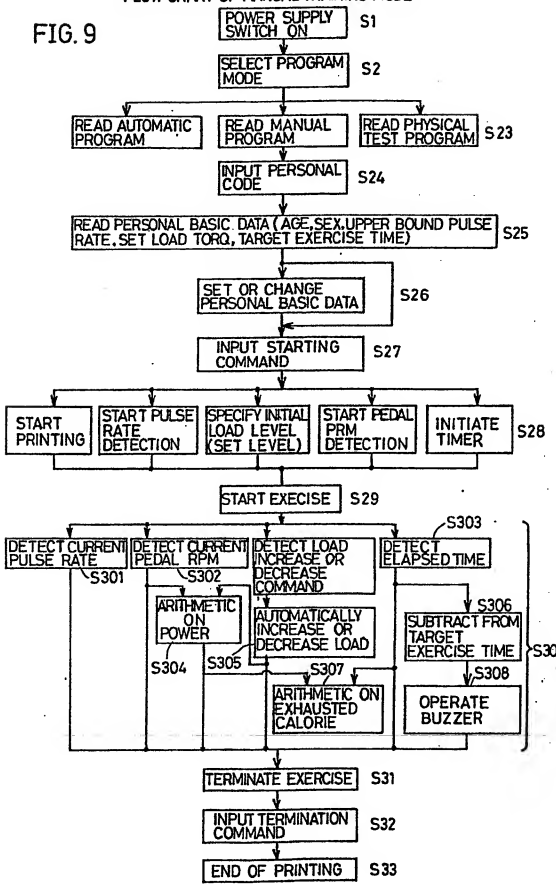

FLOW CHART OF MANUAL TRAINING MODE
POWER SUPPLY SWITCH ON
S1
SELECT PROGRAM MODE
S2
READ AUTOMATIC PROGRAM
READ MANUAL PROGRAM
READ PHYSICAL TEST PROGRAM
S23
INPUT PERSONAL CODE
S24
READ PERSONAL BASIC DATA (AGE, SEX, UPPER BOUND PULSE RATE, SET LOAD TORQ, TARGET EXERCISE TIME)
S25
SET OR CHANGE PERSONAL BASIC DATA
S26
INPUT STARTING COMMAND
S27
START PRINTING
START PULSE RATE DETECTION
SPECIFY INITIAL LOAD LEVEL (SET LEVEL)
START PEDAL PRM DETECTION
INITIATE TIMER
S28
START EXECISE
S29
S303
DETECT CURRENT PULSE RATE
S301
DETECT CURRENT PEDAL RPM
S302
DETECT LOAD INCREASE OR DECREASE COMMAND
DETECT ELAPSED TIME
ARITHMETIC ON POWER
S304
S305
AUTOMATICALLY INCREASE OR DECREASE LOAD
S306
SUBTRACT FROM TARGET EXERCISE TIME
S30
S307
ARITHMETIC ON EXHAUSTED CALORIE
S308
OPERATE BUZZER
TERMINATE EXERCISE
S31
INPUT TERMINATION COMMAND
S32
END OF PRINTING
S33

FIG. 10

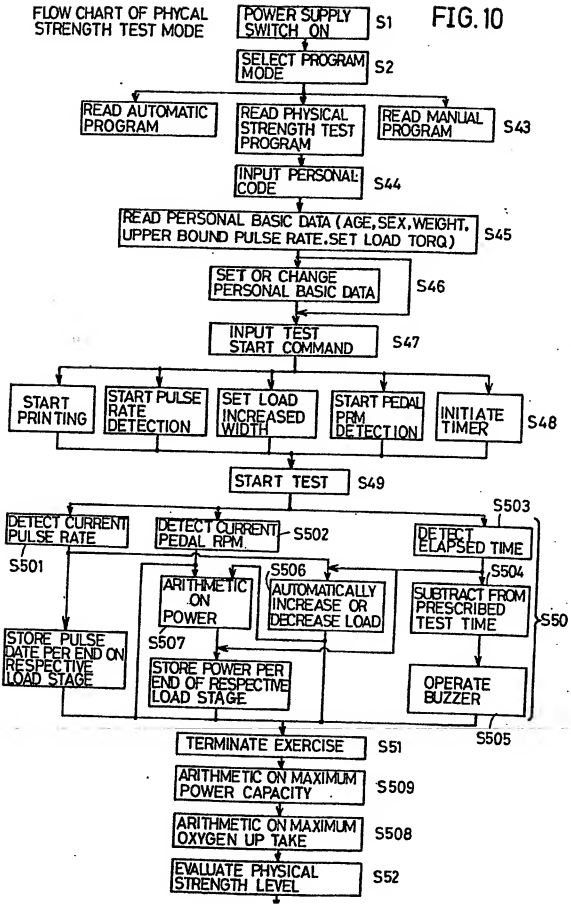

FLOW CHART OF PHYCAL STRENGTH TEST MODE
POWER SUPPLY SWITCH ON
S1
SELECT PROGRAM MODE
S2
READ AUTOMATIC PROGRAM
READ PHYSICAL STRENGTH TEST PROGRAM
READ MANUAL PROGRAM
S43
INPUT PERSONAL CODE
S44
READ PERSONAL BASIC DATA (AGE, SEX, WEIGHT. UPPER BOUND PULSE RATE. SET LOAD TORQ.)
S45
SET OR CHANGE PERSONAL BASIC DATA
S46
INPUT TEST START COMMAND
S47
START PRINTING
START PULSE RATE DETECTION
SET LOAD INCREASED WIDTH
START PEDAL PRM DETECTION
INITIATE TIMER
S48
START TEST
S49
S503
DETECT CURRENT PULSE RATE
DETECT CURRENT PEDAL RPM
S502
DETECT ELAPSED TIME
S501
S506
S504
ARITHMETIC ON POWER
AUTOMATICALLY INCREASE OR DECREASE LOAD
SUBTRACT FROM PRESCRIBED TEST TIME
S50
STORE PULSE DATE PER END ON RESPECTIVE LOAD STAGE
S507
STORE POWER PER END OF RESPECTIVE LOAD STAGE
OPERATE BUZZER
S505
TERMINATE EXERCISE
S51
ARITHMETIC ON MAXIMUM POWER CAPACITY
S509
ARITHMETIC ON MAXIMUM OXYGEN UP TAKE
S508
EVALUATE PHYSICAL STRENGTH LEVEL
S52

FIG.11

RAM ADDRESS	DATA BIT 7 6 5 4	DATA 3 2 1 0	
80 H	AGE 10^1 ORDER	AGE 10^0 ORDER	CODE NO.1
1	UPPER BOUND PULSE RATE 10^1 ORDER	UPPER BOUND PULSE RATE 10^0 ORDER	
2	TARGET PULSE RATE 10^2 ORDER	UPPER BOUND PULSE RATE 10^2 ORDER	
3	TARGET PULSE RATE 10^1 ORDER	TARGET PULSE RATE 10^0 ORDER	
4	WEIGHT 10^1 ORDER	WEIGHT 10^0 ORDER	
5	SEX	WEIGHT 10^2 ORDER	
6	SET TORQUE 10^0 ORDER	SET TORQUE 10^{-1} ORDER	
7	EXERCISE TIME (MIN) 10^0 ORDER	EXERCISE TIME (MIN) 10^0 ORDER	
8 9 A B C D E F	DITTO		CODE NO.2
90 1 3 4 5 6			
C0 1 2 3 4 5 6 7 8	DITTO		CODE NO.8
9 A B C D E F	DITTO		CODE NO.9

FIG. 12

FLOW CHART OF PHYSICAL STRENGTH EVALUATION PROCEDURE

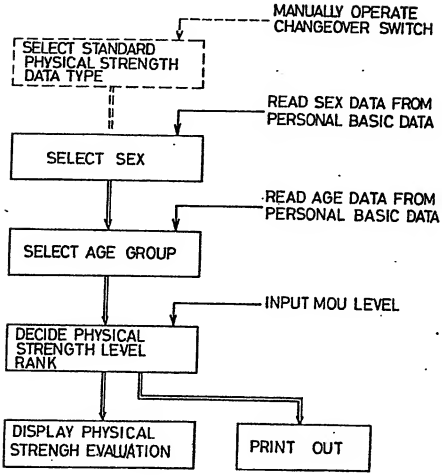


FIG. 13 EXAMPLES OF PHYSICAL STRENGTH LEVEL RANKS